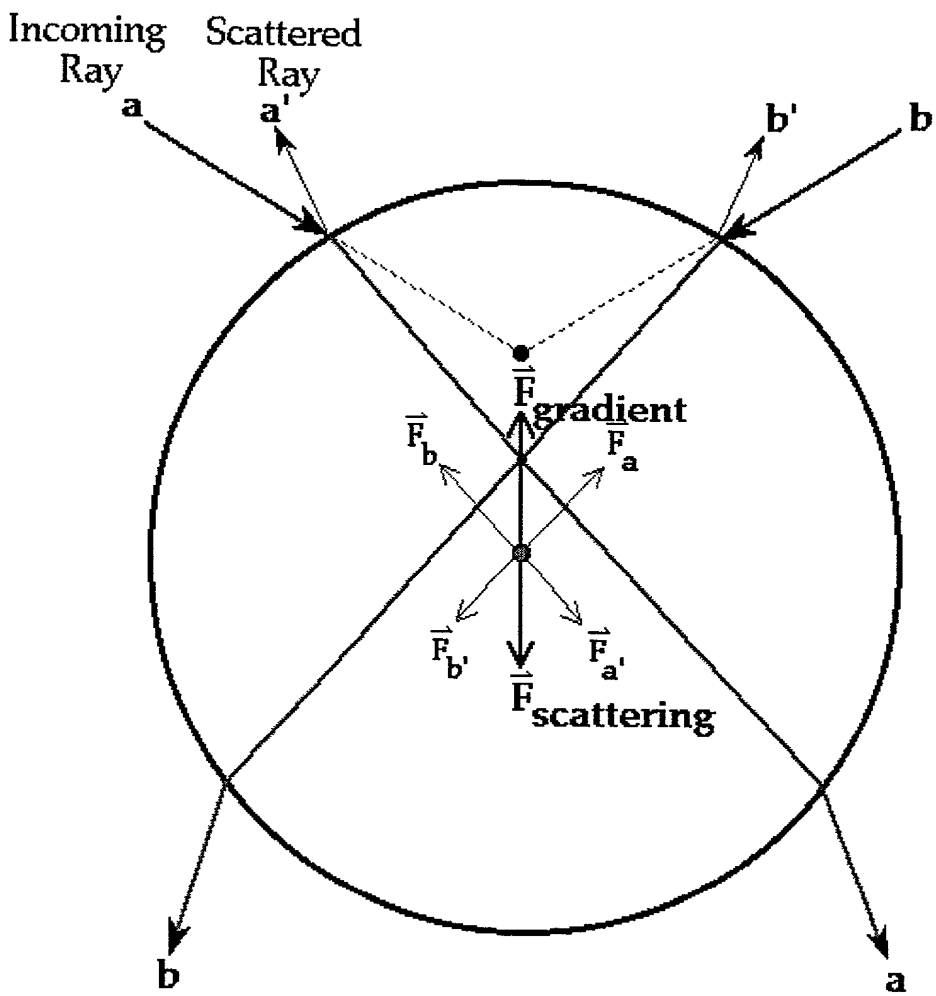
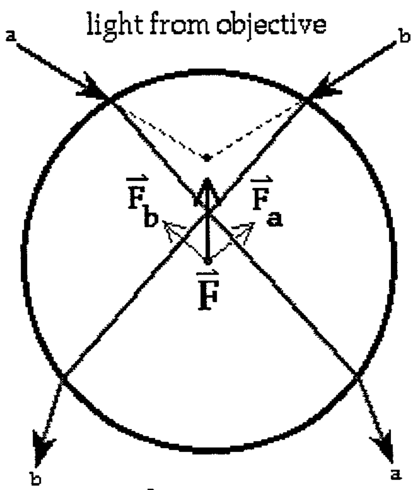


● = center of sphere

● = source focus

PRIOR ART

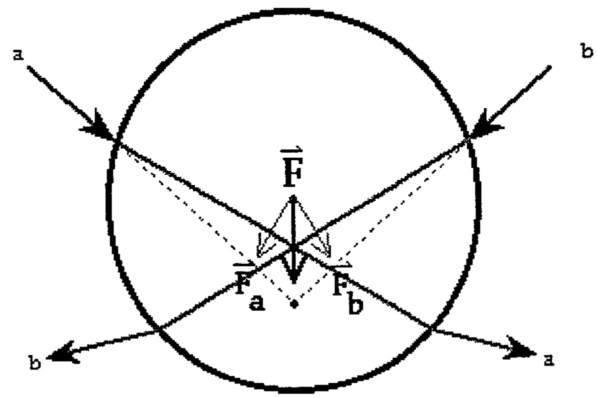
Figure 1



force up

PRIOR ART

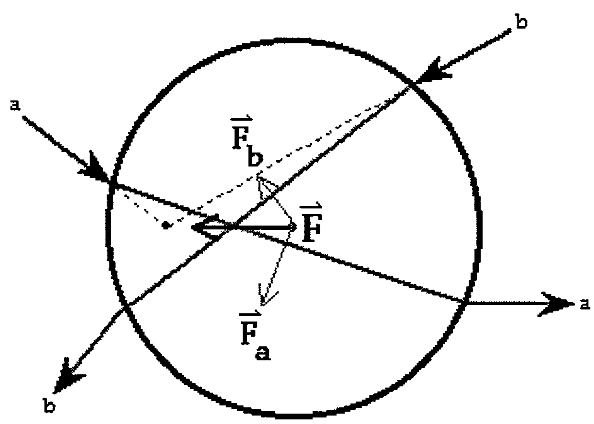
Figure 2a



force down

PRIOR ART

Figure 2b



force left

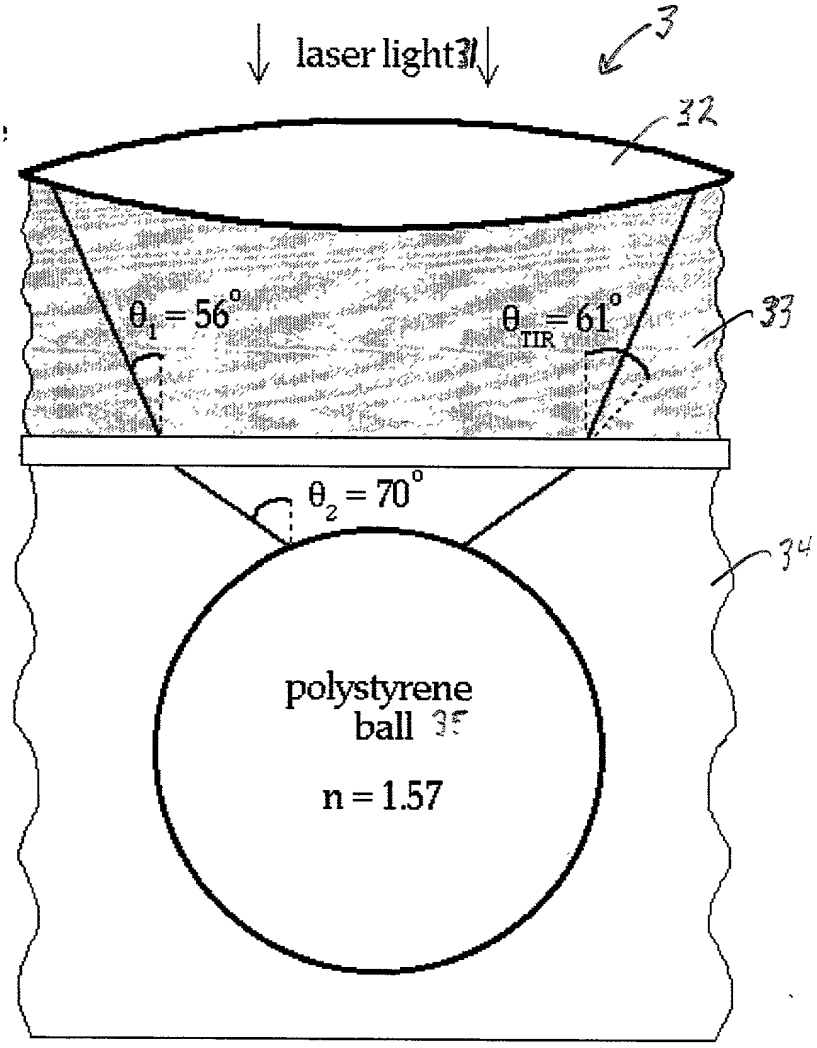
PRIOR ART

Figure 2c

• = center of sphere

• = source focus

$\vec{F}$ = gradient force



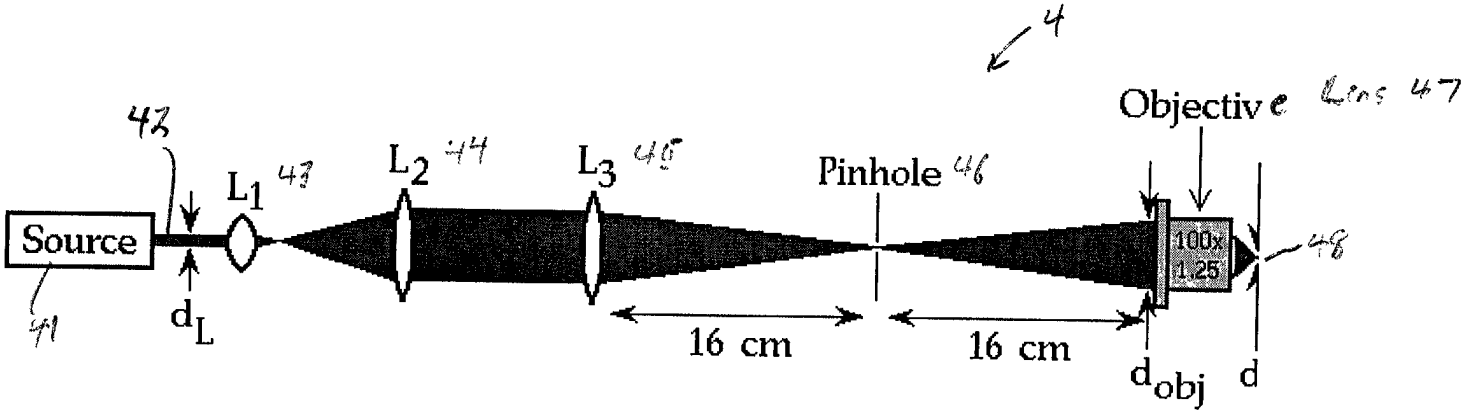
n = index of refraction

N.A. = numerical aperture

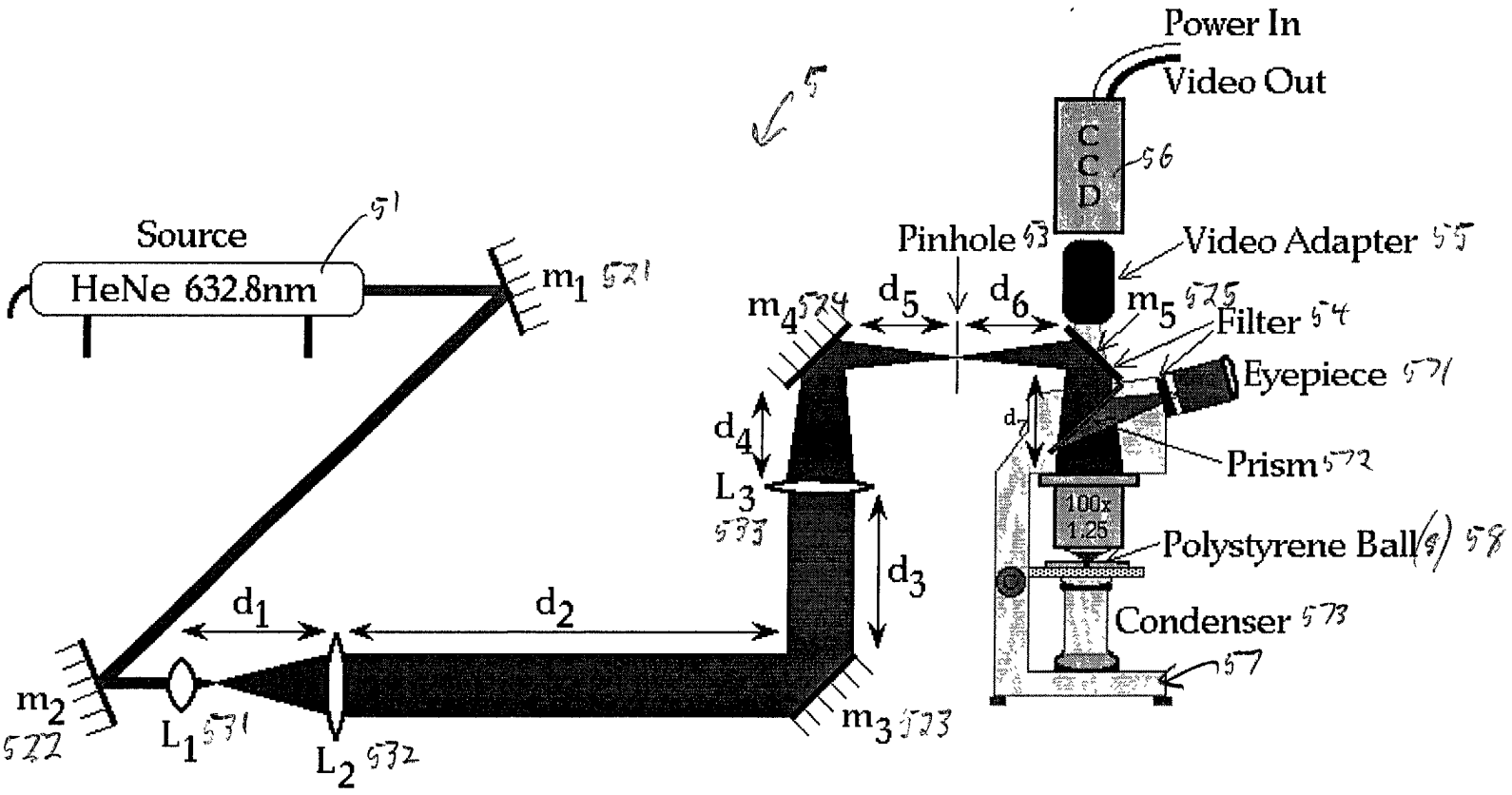
TIR = total internal reflection

PRIOR ART

Figure 3



PRIOR ART
Figure 4



PRIOR ART

Figure 5

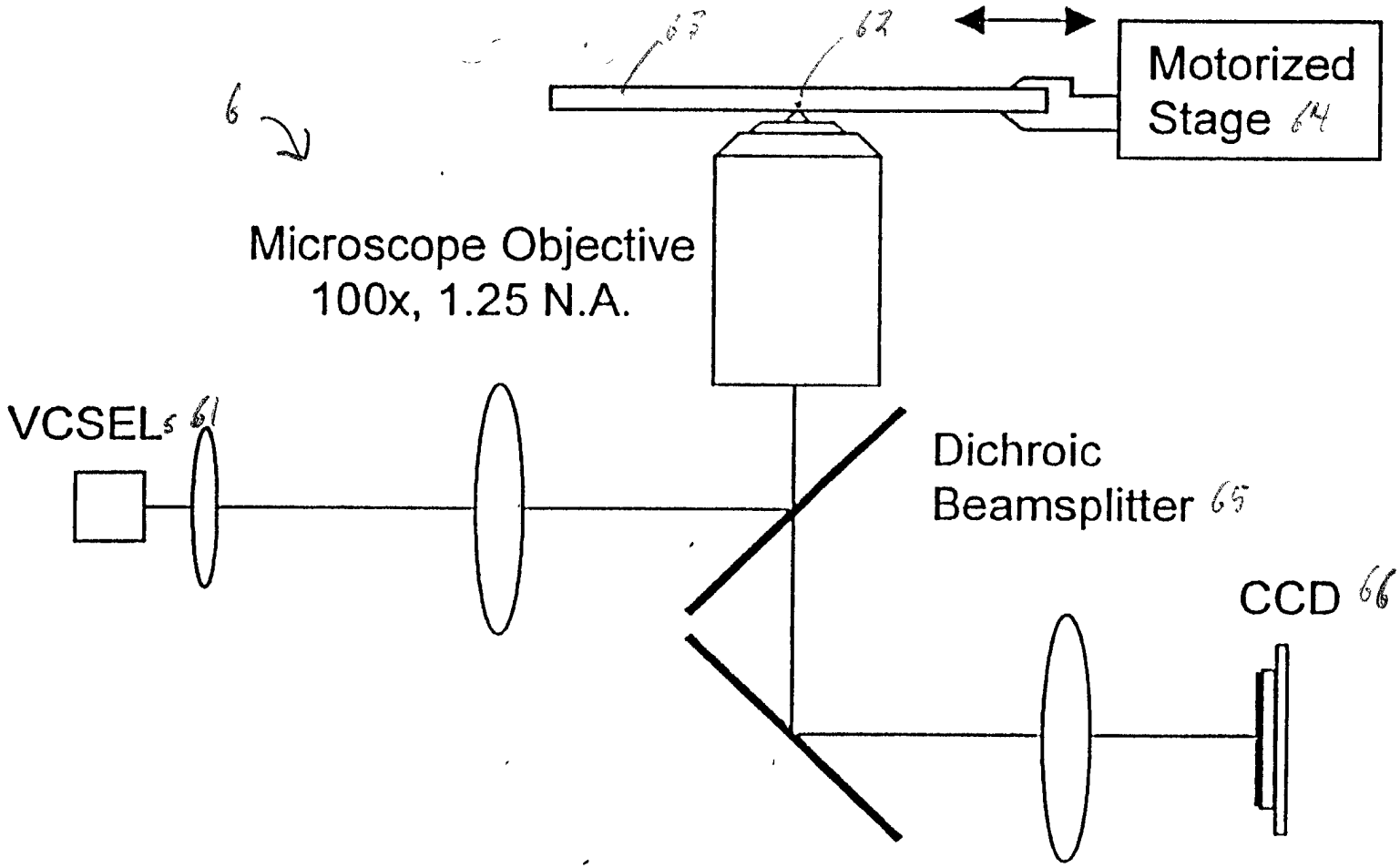


Figure 6

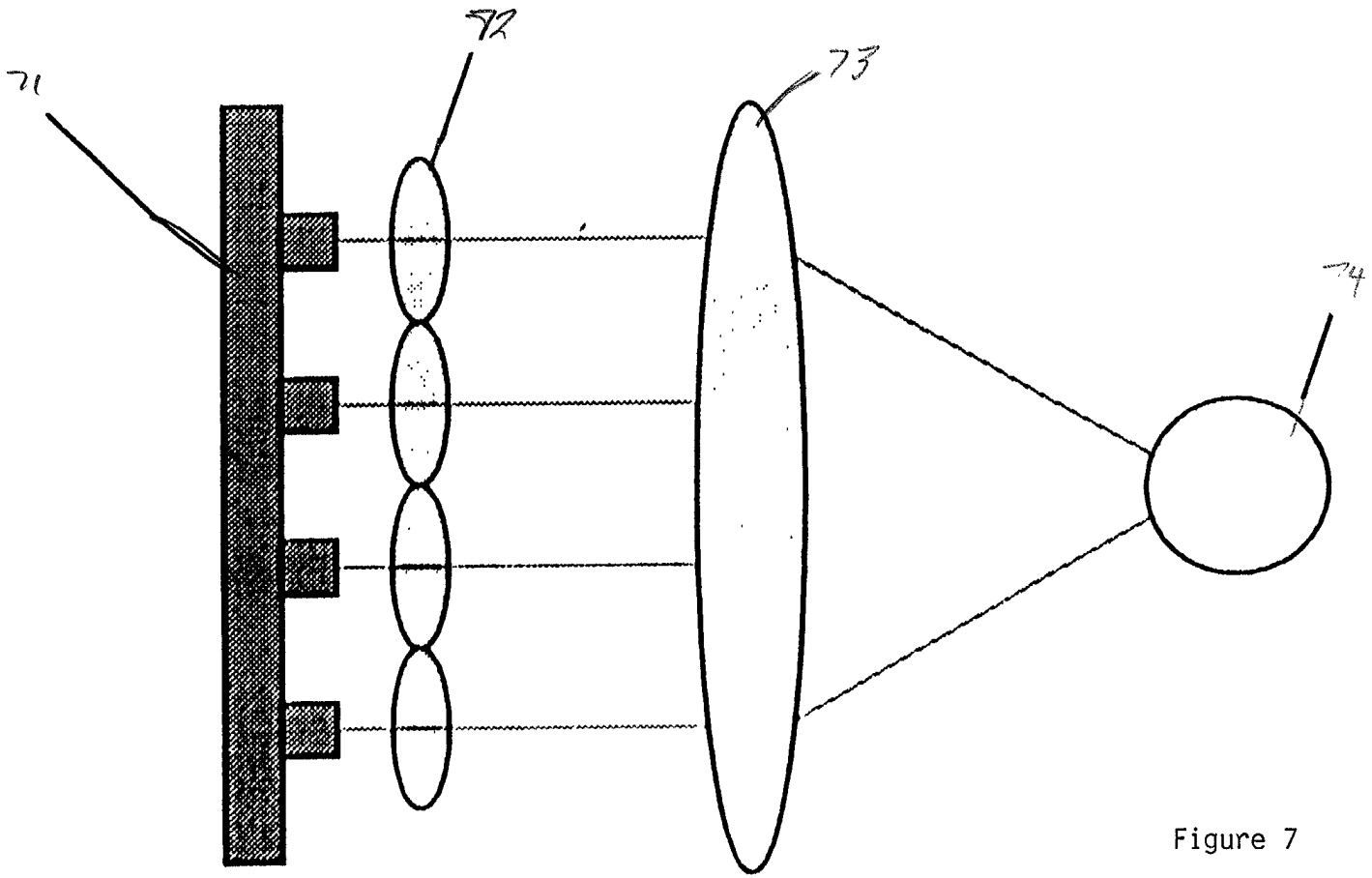


Figure 7

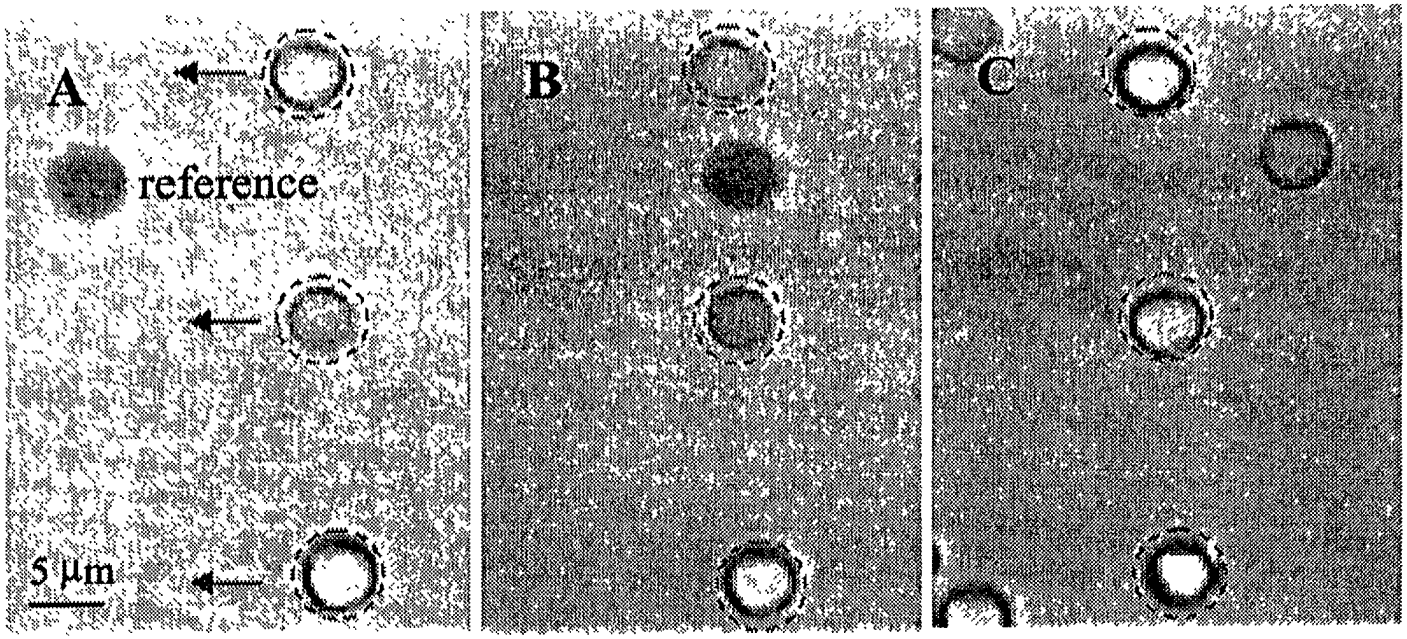


Figure 8a

Figure 8b

Figure 8c

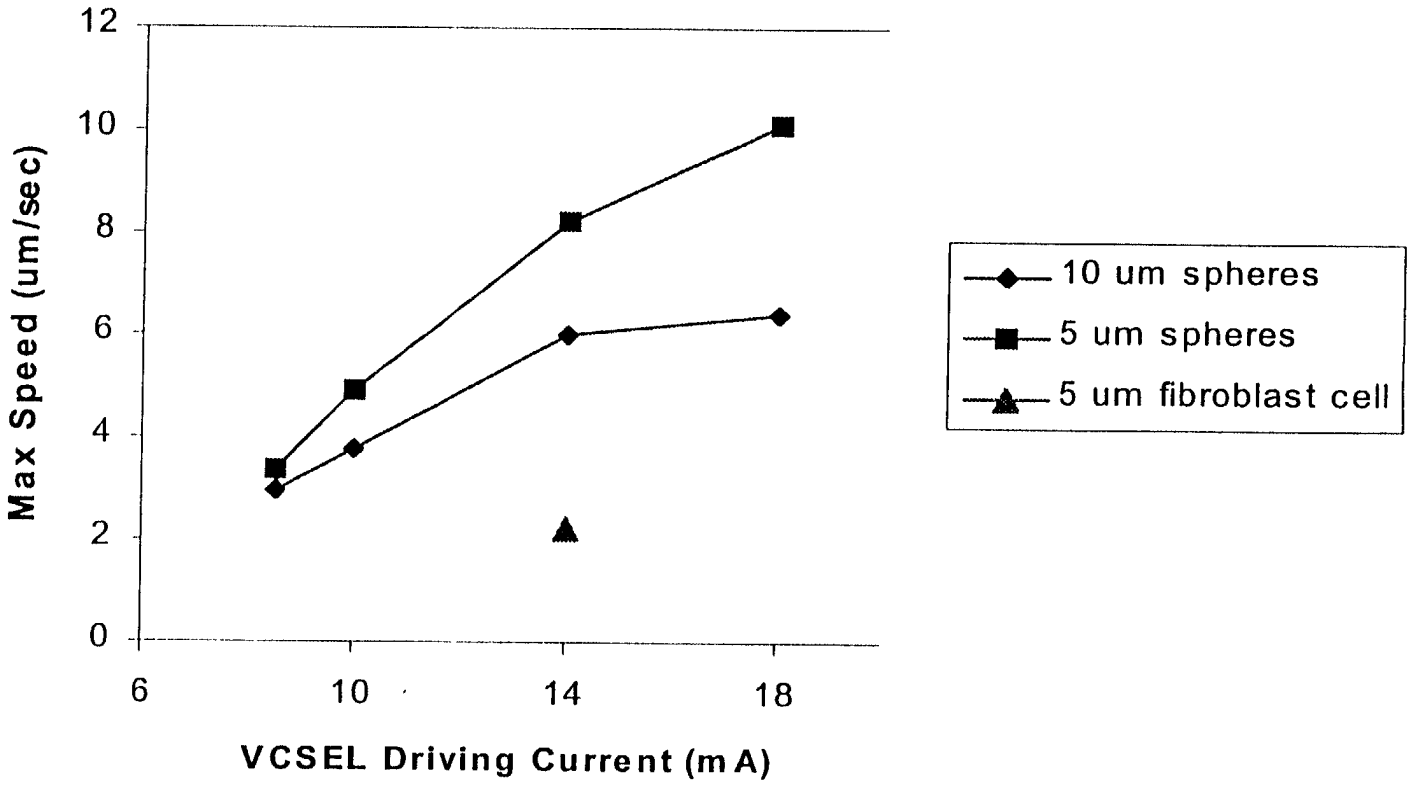

12
10
8
6
4
2
0
Max Speed (um/sec)
6
10
14
18
VCSEL Driving Current (mA)
10 um spheres
5 um spheres
5 um fibroblast cell

Figure 9

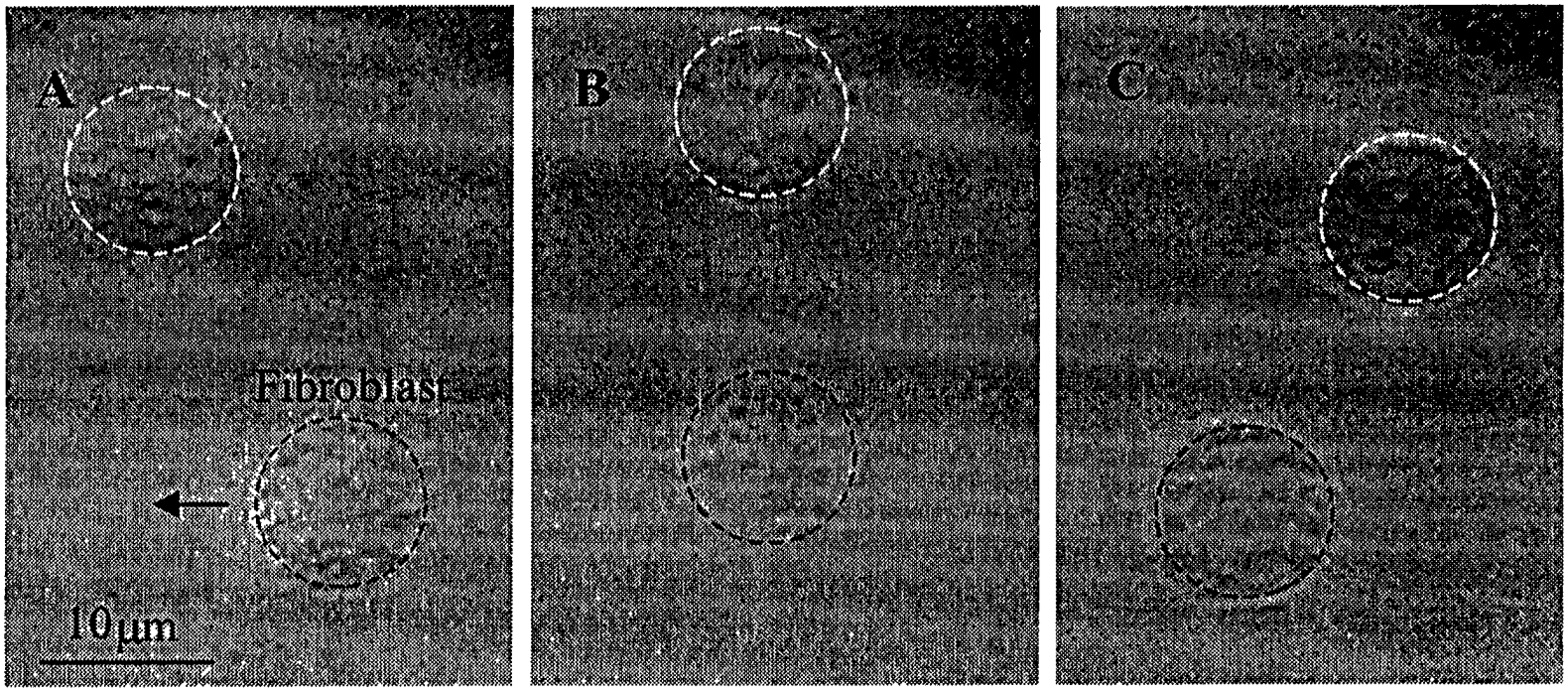


Figure 10a

Figure 10b

Figure 10c

Figure 11a

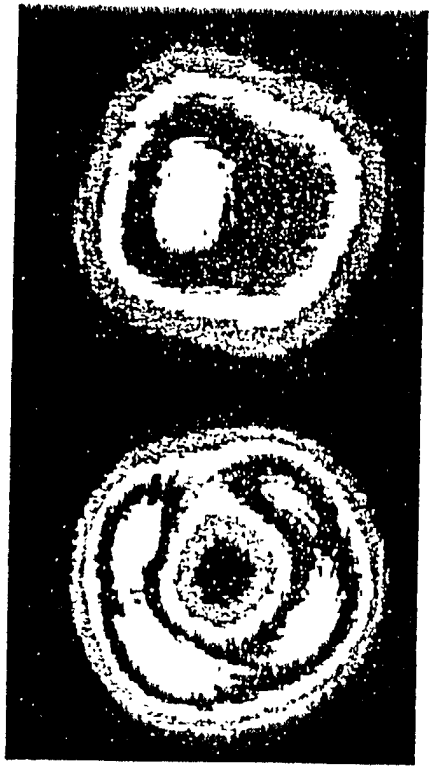


Figure 11b

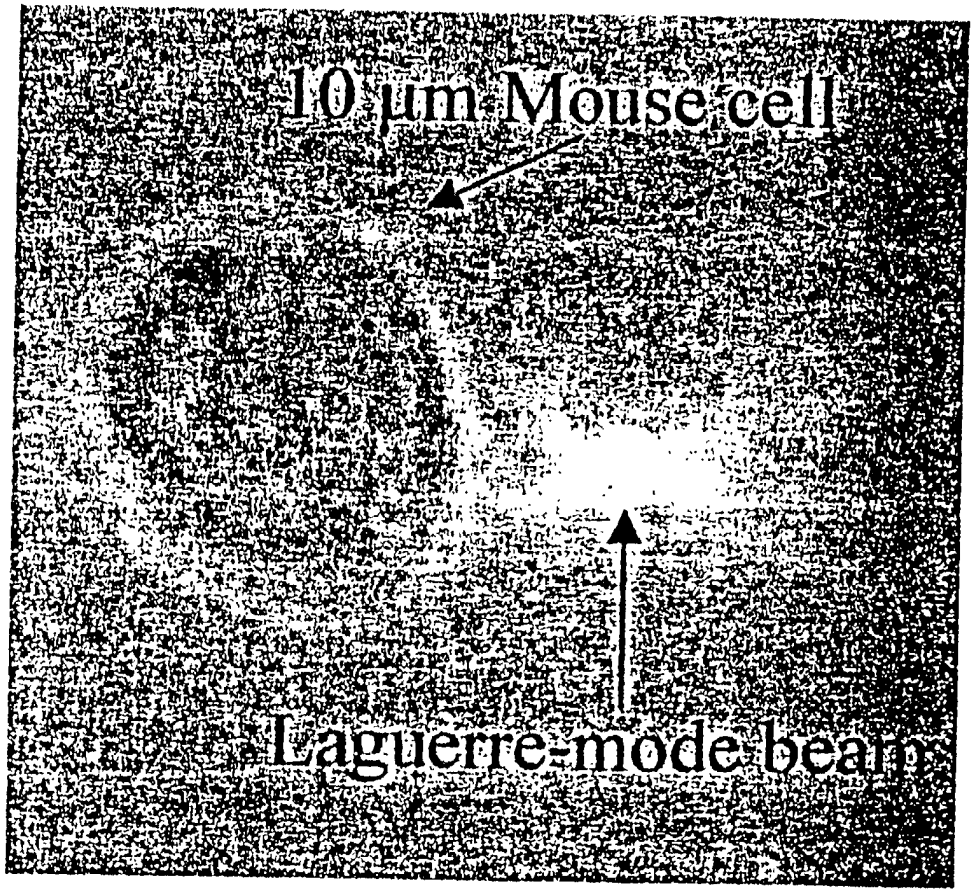
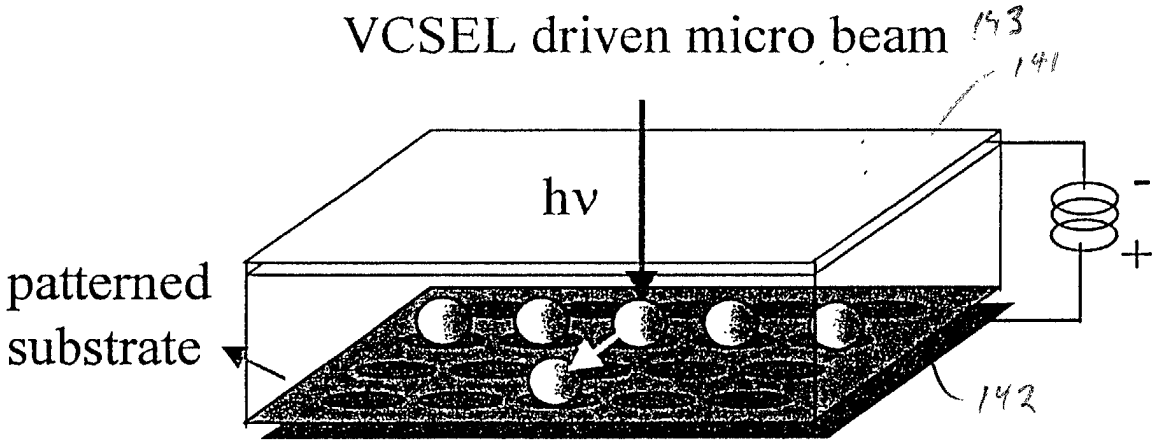


Figure 12

Measurement of trapping force on 10 μm sphere as a function of driving current

Current (mA)	Power (mW)	Power at M.O. (mW)	Speed (um/sec)	Force (pN)	Mode
5.85	0.2	*Insufficient power to trap*			
8.5	1.58	1.33	3	0.28	
10	1.76	1.3	3.75	0.35	
14	3.52	2.68	6	0.57	
18	4.4	2.46	6.4	0.6	

Figure 13



objects in a solution (device or biological cell)

Patterned substrate for electrical addressing

Figure 14